“FORTIFICATION OF CURD BY USING WALNUT OIL WITH REFERENCE TO OMEGA 3 FATTY ACID”

A Synopsis of the proposed work for

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IN

DAIRY TECHNOLOGY

Submitted By

Karuna Singh

Prof. J. N. Srivastava

Supervisor

Prof. J. N. Srivastava

Head, Department of Botany

Prof. G S Tyagi

Dean Faculty Of Science

DEPARTMENT OF BOTANY

DAYALBAGH EDUCATIONAL INSTITUTE, AGRA

DAYALBAGH AGRA

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1. INTRODUCTION

1.1 WALNUT

The Walnut (*Juglans regia* L.) is one of the World's most venerable fruits. The Romans associated the walnut with the Juno, the Roman goddess of women and the wife of Jupiter. This association led to the unique wedding practice of throwing walnuts at the bride and groom as a symbol of fertility. William Cole, an exponent of the doctrine of signatures, said in Adam in Eden, 1657 that Walnuts have the perfect Signature of the Head: The outer husk of green Covering, represents the outward skin of the skull, upon which the hairs grow, and therefore salt made of these husks or barks, may help in healing wounds of the head. Every 100 grams of edible portion of walnut contains as much as 68 grams of fat, in which a majority is the polyunsaturated fatty acid, such as Linoleic Acid and Linolenic Acid, accounting for 70% of the total fatty acid. (Milind et al, 2011). Walnut (*Juglans regia* L.) is a highly nutritious food, which is rich in polyunsaturated fatty acids (PUFAs) and has shown to protect the brain from numerous insults associated with aging and may possibly allay age-related cognitive decline. The major fatty acids found in walnut oil are oleic, linoleic, and linolenic acids. (Li et al, 2014).

Walnut (Juglans sp.) is the most important temperate nut fruit of the country. Walnut in India are found in differet sizes and shapes. The Indian walnuts are categorized into 4 categories viz., paper-shelled, thin-shelled, medium-shelled and hard-shelled.

Areas of Cultivation :

The major growing area is Jammu and Kashmir, Uttaranchal and Himachal Pradesh and Arunachal Pradesh, with Jammu & Kashmir occupying the largest share in total area and production.

India Facts and Figures :

The country has exported 2,191.19 MT of Walnuts to the world for the worth of Rs. 55.27 crores/ 8.27 USD Millions during the year 2016-17.

Major Export Destinations (2016-17): The major importing countries of walnut from India are France,United Kingdom, Netherlands, United Arab Republic, Nepal ,Germany and Sweden. (http://apeda.gov.in)

Walnut trees will flourish in a well-drained, loamy soil. The walnut should be grown on deep, fertile, light (sandy) ground, which is free from alkali. It needs to be moist all the time. The pH of the soil should be 6-8. Climatic Conditions Walnuts are light-demanding species. The best locations for walnut trees are sunny, relatively sheltered sites with deep, well drained loam. They need protection from wind. Walnuts are also very hardy against drought. Walnuts are quite intolerant of wet climates, and may not fruit successfully in locations, where the annual rainfall exceeds 40 inches. (Milind et al, 2011).

1.2 CURD

Yoghurt/curd is a sour semisolid fermented food linked to india which can be eaten plain or with sweet or salt. Hindi word dahi is derived from Sanskrit word dadhi one of the five elixirs (panchamrita). It is having probiotic effects when consumed and possesses functional properties. (Milind et al, 2014).

With the advent of health foods, dahi is valued for controlling the growth of intestinal bacteria and incurring intestinal diseases like constipation, diarrhoea and dysentery. Dahi is also found effective in lowering blood cholesterol. Dahi is not only popular for its therapeutic value but its nutritive value is also unique. It contains all the nutrients present in milk except a little variation in lactose content. Lactose content of dahi is about 30 % (per cent) lower than milk as because some portion of lactose is fermented for the formation of lactic acid.(Akter et al, 2010).

1.3 FORTIFICATION

Food fortification (FF) is defined as the addition of one or more essential nutrients to a food, whether or not it is normally contained in the food, for the purpose of preventing or correcting a demonstrated deficiency of one or more nutrients in the population or specific population groups Commercial

fortification involves fortifying commercially available products such as flour, rice, cooking oils, sauces, butter etc. with micronutrients and the process occurs during manufacturing. Home fortification consists of supplying deficient populations with micronutrients in packages or tablets that can be added when cooking/ consuming meals at home. (Hettiarachchi et al, 2011).

Fortification of milk with micronutrients plays a major role in relieving nutritional deficiency problems in humans. It can improve the palatability and sensory of the products. (Sathya et al, 2016).

The consumption of saturated fats increases the risk of coronary heart diseases thus fortification of milk products with good fats such as omega 3 fatty acids can be beneficial in controlling the heart related issues. In India 9% of total milk production is converted into fermented milk products and out of them 77% is converted into curd so curd can be a good option of fortification.(Goyal et al, 2016) since omega 3 fatty acids are anti inflammatory. Walnuts are good source of these omega 3 fatty acids. At least 1 g per day of omega 3 fatty acids is recommended for cardio-protection. (Convington, 2004).

The literature revealed the facts in support with the utilization of walnuts for fortification of curd, since on the basis of study conducted by (Li et al, 2014), Walnut (*Juglans regia* L.) is found rich in polyunsaturated fatty acids (PUFAs) and has shown to protect the brain from numerous insults associated with aging and may possibly allay age-related cognitive decline. The major fatty acids found in walnut oil are oleic, linoleic, and linolenic acids. According to Akter et al, (2010) curd is also a good source of nutrients and beneficial microbes to maintain the gut micro-flora from ancient time. Literature revealed that curd is valued for controlling the growth of intestinal bacteria and controlling intestinal diseases. Curd is not only popular for its therapeutic value but its nutritive value is also unique. It contains not only the nutrients present in milk but the benefit of additional lactic acid and a set of beneficial microorganisms. On the basis of literature review the following objectives can be considered for research work.

OBJECTIVE:

1. Fortification of milk with walnut oil to add benefits of omega 3 fatty acids.
2. Preparation of curd with walnut oil fortified milk.
3. Analysis of walnut oil fortified curd with reference to omega 3 fatty acids and its comparison of curd before and after fortification.
4. Use of plant based gum (pectin), to improve the consistency of curd.

2.0 REVIEW OF LITERATURE

2.1 CURD:

Curd is a fermented food product produced using a culture of *lactobacillus delbrueckii* subsp. *bulgaricus* and *streptococcus salivarius* subsp. *thermophilus* bacteria. In addition, *lactobacillus acidophilus, lactobacillus bifidus* and *lactobacillus casei* are also sometimes used in culturing curd. (sudhir et al, 2012). On the basis of studies of the various authors, following conclusions were observed.

AUTHOR	YEAR	STUDY
Amal et al (2016)	2016	Studied the Chemical, Functional and Rheological Properties of Fruit Flavored Yoghurt and found that the addition of fruits to the yogurt significantly improved the quality of yogurt.
Dutta et al (2016)	2016	Studied the development and characterization of curd fortified by pineapple juice and found that the addition of fruits to the curd significantly improved the quality of curd.
Ghosh and Chattopadhdhyay (2016)	2016	Studied process of fortification of cow milk curd with beta (ß) carotene producing sweet potato and found through the research that addition of sweet potato increased the firmness of curd.
Reeta et al (2016)	2016	Studied on, development and characterization of greek probiotic dahi fortified with pomegranate pulp and found that, greek probiotic dahi fortified with 20% pomegranate pulp pomegranate pulp is a nutritious food with high acceptance by consumers.
Goyal et al (2016)	2016	Studied the effects of fortification of curd (Indian yoghurt) with omega-3 fatty acids using microencapsulated flaxseed oil microcapsules, and results showed that, flaxseed oil microcapsules could be successfully incorporated in curd which could serve as a potential delivery system of omega-3 fatty acids.
Nkhata et al (2015)	2015	Studied the effect of iron fortification in curd

		and found that there was no noticeable difference in control sample and fortified yoghurt.
Temesgen and Yetneberk(2015)	2015	Studied the effect of application of stabilizers on gelation and synersis in yoghurt and he found that the application of stabilizers in yoghurt manufacturing will bring a positive effect on product stability and consumer acceptance.
Weerathilake et al (2014)	2014	The evolution, processing, varieties and health benefits of yogurt and found that yoghurt is functional food, due to its nutrient profile and is a rich source of calcium that provides significant amounts of calcium in bio-available form. In addition, it provides milk proteins with a higher biological value and provides almost all the essential amino acids necessary to maintain good health. Yogurt is considered as a probiotic carrier food that can deliver significant amounts of probiotic bacteria into the body which can claim specific health benefits once ingested.
Milind and malik (2014)	2014	In his work studied about the various properties of curd and found that, besides being easily available curs is having ample of health benefits, including designated as functional foods.
Jothi et al (2012)	2012	Studied about uses of bacteriocin production by probiotic bacteria from curd and its field application to poultry, and he concluded that the comparison with control are increased in Weight and better feed supplement efficiency has been determined in chicks.
Balamurugan et al (2014)	2014	Studied the probiotic potential of lactic acid bacteria present in homemade curd in southern india and concluded that lab in curd had properties consistent with probiotic potential, but these were not consistent across species.
Ramanathan and Sivakumar (2013)	2013	Evaluated the fiber enriched and vitamin – C fortified sweetened probiotic dahi and found that the maximum level of oats recommended for preparation of fibre enriched dahi is two percent of milk. Inclusion of oats at two percent level in milk produced dahi of high

		nutritive value as well as desirable sensory attributes.
Cimo et al (2013)	2013	Studied the fortification of probiotic yogurt with ginseng (*Panax quinquefolius*) extract, and concluded that yogurt combined with aqueous ginseng extract is suitable for Rhamnosus, and there is a synbiotic relationship between the prebiotic components of ginseng and Rhamnosus. Research suggests that the bioactive components of ginseng can decrease oxidative stress.
Parnami, and Sheth (2011)	2011	Concluded by their work that indian fermented milk (*dahi*) fortified with probiotic bacteria and inulin improves serum lipid, blood glucose levels and gut microflora.
Amira et al (2011)	2011	Studied the effect of fortification of yoghurt with iron and found that sensory characteristics scores did not detect any significant differences in the flavours, appearance or overall quality between fortified and unfortified yoghurt. All yoghurt samples were acceptable, suggesting that yoghurt is a suitable vehicle for iron fortification.
Akter et al (2010)	2010	Studied the effects of different level of starter culture and sugar on manufacturing characteristics of misti dahi (sweet yoghurt), and found that sugar level and culture level both can changes the quality of dahi samples. A combination of 10% sugar with 2% culture and 12% sugar with 3% culture was found appropriate for dahi making.
Cavallini et al (2009)	2009	Studied about soy yogurt fortified with iron and calcium and the stability during the storage and found that the work enabled the development of a iron and calcium fortified soy yogurt, stable during 28 days at 10°c, that could be used in the prevention and control of mineral deficiencies in general population.

2.2 Walnuts (*Juglans regia)*

Walnuts are among the most widely consumed commercially grown tree nuts in the world. Many health benefits have been claimed for the consumption of these, including reduced risk of cardiovascular disease, coronary heart disease, type II diabetes treatment, and prevention and treatment of certain cancers, and the lessening of symptoms attributed to age-related and other neurological disorders. The health-promoting benefits of walnut consumption are ascribed to its fatty acid profile, which is rich in polyunsaturated fatty acids with a particularly high ω3:ω6 ratio-the highest among all the tree nuts. (Hayes et al, 2016). The following studies have been made regarding the uses and benefits of walnuts.

AUTHOR	YEAR	STUDY
Pribis (2016)	2016	Studied the effects of walnut consumption on mood in young adults and concluded that walnuts contain a number of potentially neuroprotective compounds like vitamin E, folate, melatonin, several antioxidative polyphenols and significant amounts of !-3 fatty acids, and in non-depressed healthy young males, walnuts seem to have the ability to improve mood.
Li et al (2014)	2014	The study was conducted to find the antioxidants properties of walnut oil and it was found that walnut oil exhibit antioxidant properties.
Moigradean et al (2013)	2013	This study was to identify the fatty acid composition of two different vegetables oils(walnut and coconut oils) by gas chromatography-mass spectrometry (gc-ms) method. The content of saturated fatty acids in the studied walnut oil was 9.5%, which of monounsaturated acids was 24.2%, and that of polyunsaturated acids was 63.3%. The oleic acid content of the walnut oil was 24.2% of the total fatty acids, while the linoleic acid content was 54.8% and the linolenic acid was 8.5%.
Boycheva et al (2012)	2012	Studied about the amino acid and fatty acid content of yogurt supplemented with walnut

		and hazelnut pieces and found that the amount of unsaturated fatty acids in the yogurt with walnuts and hazelnuts was by 39% higher in comparison with natural yogurt. The amount of polyunsaturated fatty acids in the yogurt with walnut pieces was almost three times higher in comparison with control yogurt.
Andronoiu et al (2011)	2011	Studied the effects of addition of walnuts in yoghurt with strawberries jam and found that yoghurt was with improved Properties.
Milind and Khanna (2011)	2011	Studied about the properties of walnuts and found it very useful in controlling various diseases.
Kendall et al (2010)	2010	Studied the health benefits of nuts in prevention and management of diabetes and concluded that nuts are low in available carbohydrate, have a healthy fatty acid profile, and are high in vegetable protein, fiber and magnesium. Acute feeding studies indicate that when eaten alone nuts have minimal effects on raising postprandial blood glucose levels.

2.3 FORTIFICATION

AUTHOR	YEAR	STUDY
Rakib et al(2016)	2016	The work showed the potential of coconut as an alternative source of skim milk in dahi manufacturing with improved nutritional value and consumer acceptability.
Sathya et al(2016)	2016	Studied and concluded that fortification of milk with micronutrients play a major role in releaving nutritional Deficiency problems in humans. It can improve the palatability and sensory of the products.

Jeelani et al(2014)	2014	Investigation was made with an attempt to develop processed paneer by partial addition of different levels of skimmed milk and soymilk, and concluded that skimmed milk can be utilized for the production of soy paneer with higher consumer acceptability. The product can retain its quality attributes especially the colour and flavor during refrigeration storage.
Hettiarachchi (2011)	2011	Studied the importance of fortification and showed that the addition of one or more essential nutrients to a food, whether or not it Is normally contained in the food, for the purpose of preventing or correcting a demonstrated deficiency of one or more nutrients in the population or specific population groups.

4.0 PLAN OF WORK

On the basis of literature review, walnut was found to be nutritious and rich in some essential fatty acids especially omega 3 fatty acids, so it's properties can be utilized to fortify curd. However curd itself is a packet of so many health promoting qualities but addition of walnut oil will enhance them; on the other hand use of pectin a plant based stabilizer will improve the texture of curd. By considering the research on fortification of curd with flaxseeds (Goyal et al, 2016) the following plan of work is being prepared.

- Preparation of milk
- Preparation of walnut curd- This operation is further divided into three categories.
    a. Optimization of walnut oil content (Boycheva et al, 2012)
    b. Optimization of pectin content (Temesgen et al, 2015)
    c. Optimization of sugar content (Akter et al, 2010)
- Analysis of walnut curd

4.1 Preparation of milk-

Raw milk

⇩

Platform tests

⇩

Filtration

⇩

Cream separation

⇩

Skim milk pasteurization

⇩

Homogenization

⇩

Skim milk Cooled to 5^0 C

4.2 Preparation of walnut curd- This section is divided into three sub- sections, as optimization of walnut oil, optimization of **pectin content and optimization of sugar content.**

4.2.1 Optimization of walnut content- Based on the study of (Boycheva et al, 2012) the following method is adopted for optimization of walnut oil content**.**

Skim milk

⇩

Addition of walnut/walnut oil in obtained skim milk @ 2%,4%,6%,8%,10%

⇩

Preheating of milk to 45^0 C

⇩

Inoculation of culture @ 1-2%

⇩

Incubation of cultured milk @ 45^0 C

⇩

Storage of curd @5^0 C

⇩

Sensory evaluation

⇩

The best sample formulation is obtained for further use.

4.2.2 Optimization of pectin content- optimization of pectin content is done with the sample obtained after optimization of walnut oil on the basis of overall acceptability. In this step the walnut oil optimized formulation will be used to set the amount of pectin to be added.

Skim milk with added walnut oil in given %.

⇩

Addition of pectin @ 0.1, 0.2, 0.3, 0.4, 0.5%

⇩

Preheating of milk to 45^0 C

⇩

Inoculation of culture @ 1-2%

⇩

Incubation of cultured milk @ 45^0 C

⇩

Storage of curd @5^0 C

⇩

Sensory evaluation

4.2.2 Optimization of sugar content

Skim milk

⇩

Addition of walnut/walnut oil in obtained skim milk , with pectin, and sugar @ 10% and 12%

⇩

Preheating of milk to 45^0 C

⇩

Inoculation of culture @ 1-2%

⇩

Incubation of cultured milk @ 45^0 C

⇩

Storage of curd @5^0 C

⇩

Sensory evaluation

4.3 Analysis of curd

a. Nine point hedonic scale Sensory evaluation
b. Physicochemical analysis
c. Shelf life study

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